

PATENT COOPERATION TREATY

RECEIVED

MAY 22 2001

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

SCHWAPPACH, Karl, G.
Faegre & Benson, LLP
2200 Wells Fargo Center
90 South Seventh Street
Minneapolis, MN 55402-3901
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year)

11 May 2001 (11.05.01)

Applicant's or agent's file reference

220294

IMPORTANT NOTIFICATION

International application No.

PCT/US00/20748

International filing date (day/month/year)

31 July 2000 (31.07.00)

1. The following indications appeared on record concerning:



the applicant



the inventor



the agent



the common representative

Name and Address

GRAPHICS, INC.
Suite 140
3850 Annapolis
Plymouth, MN 55447
United States of America

State of Nationality

US

State of Residence

US

Telephone No.

612/509-0066

Facsimile No.

612/509-0077

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:



the person



the name



the address



the nationality



the residence

Name and Address

GRYPHICS, INC.
Suite 140
3850 Annapolis
Plymouth, MN 55447
United States of America

State of Nationality

US

State of Residence

US

Telephone No.

612/509-0066

Facsimile No.

612/509-0077

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:



the receiving Office



the International Searching Authority



the International Preliminary Examining Authority



the designated Offices concerned



the elected Offices concerned



other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Dominique BELMAS

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 09 April 2001 (09.04.01)	
International application No. PCT/US00/20748	Applicant's or agent's file reference 220294
International filing date (day/month/year) 31 July 2000 (31.07.00)	Priority date (day/month/year) 02 August 1999 (02.08.99)
Applicant RATHBURN, James, J.	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

28 February 2001 (28.02.01)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. Mafla Telephone No.: (41-22) 338.83.38
---	--

REPLACED BY
ART 34 AMEND.

PATENT COOPERATION TREATY

PCT

REC'D 16 OCT 2001

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 52191-220294	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/20748	International filing date (day/month/year) 31/07/2000	Priority date (day/month/year) 02/08/1999
International Patent Classification (IPC) or national classification and IPC H01L21/66		
Applicant GRAPHICS INC. GRAPHICS, INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 12 sheets, including this cover sheet.
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 11 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 28/02/2001	Date of completion of this report 11. 10. 01
Name and mailing address of the international preliminary examining authority:  European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized officer Munnix, S Telephone No. +49 30 25901 626 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/20748

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-3,5-28	as originally filed			
4,4a-4b	as received on	19/07/2001	with letter of	19/07/2001

Claims, No.:

1-42	as received on	19/07/2001	with letter of	19/07/2001
------	----------------	------------	----------------	------------

Drawings, sheets:

1/19-19/19	as originally filed
------------	---------------------

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US00/20748

- ☐ the description, pages:
☒ the claims, Nos.: 43-48
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☒ restricted the claims.
☒ paid additional fees.
☐ paid additional fees under protest.
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
☒ not complied with for the following reasons:
see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 1-42
 No: Claims

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/20748

Inventive step (IS) Yes: Claims
 No: Claims 1-42

Industrial applicability (IA) Yes: Claims 1-42
 No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item IV

Lack of unity of invention

The application lacks unity within the meaning of Rule 13.1 PCT because for the reasons given below, the following (groups of) inventions are not so linked as to form a single general inventive concept:

(1) Claims 1 to 16 and 42: Electrical connector for interconnecting terminals on a flexible circuit member with terminals on a second circuit member, interconnect assembly using the same, and method of manufacturing the same,

where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing to couple with respective circuit members, and where a resilient member controls the movement of the contact members along their central axis,

characterized in that the resilient member comprises a compliant encapsulating material between a portion of the through holes and a portion of the respective contact members.

(2) Claims 17 to 41: Electrical connector for interconnecting terminals on a flexible circuit member with terminals on a second circuit member, interconnect assembly using the same, and method of manufacturing the same,

where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing to couple with respective circuit members, and where a resilient member controls the movement of the contact members along their central axis,

characterized in that the resilient member comprises the flexible circuit member, to which the contact members are attached by one of their ends.

1. Document D1 = US 5 252 916 A discloses (see in particular figures 1 and 2 and accompanying text) an electrical connector in an electrical interconnect assembly, and a method of manufacturing the same, where a flexible circuit member (30) is electrically interconnected with a second circuit member (see the circuit elements

on printed circuit board 12), comprising: providing a housing (support plate 16) with a plurality of through holes (bores 20) extending between a first and a second surface of housing (16) and defining a central axis; positioning a plurality of elongated contact members (test probes 24) in the through holes (20) along their central axes, the contacts having first (28) and second (26) ends extending respectively above the first and second surface of housing (16); retaining the electrical contact members (24) in through holes (20) by a resilient member (elastomeric diaphragm 42; see column 7, lines 23 to 24) such that the movement of the contact members (24) along their respective central axes is controlled; and electrically coupling the first ends (28) with the terminals (22) of a flexible circuit member (30).

2. The following technical feature of the claims of the first group of inventions can be seen to make a contribution over the above teaching of D1 and is therefore considered to be an STF of the invention in the sense of Rule 13.2 PCT:
 - The resilient member comprises a compliant encapsulating material between a portion of the through holes and a portion of the respective contact members.

The objective technical problem to be solved by this STF may be seen as retaining the contact members in the through holes while keeping the connector as thin as possible.

3. Likewise, the STF of the second group of inventions is:
 - The resilient member comprises the flexible circuit member, to which the contact members are attached by one of their ends.

The objective technical problem to be solved by this STF may be seen as retaining the contact members in the through holes by using a part external to the connector, thus simplifying the manufacturing process of the connector.

4. Thus, the (groups of) independent claims mentioned above do not present a single common STF, nor are these STF's corresponding ones, since they do not solve a single common objective problem. Therefore, the technical relationship required by Rule 13.2 PCT is not present between these groups of claims.

R Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

- D1: US 5 252 916 A (M.A. SWART) 12 October 1993
- D2: US 4 118 090 A (L.G. DEL MEI) 3 October 1978
- D3: WO 98/13695 (PRIMEYIELD SYSTEMS) 2 April 1998
- D4: US 5 723 347 A (T. HIRANO et al.) 3 March 1998
- D5: US 5 412 329 A (S. IINO et al.) 2 May 1995
- D6: EP 310 302 A (MINNESOTA MINING) 5 April 1989
- D7: US 5 645 433 A (D.A. JOHNSON) 8 July 1997

2. Attention is drawn to Re Item VIII, sections 1 and 2, below, concerning the interpretation of claims 1, 2 and 17.

3. The subject-matter of independent claims 1 and 42 does not meet the requirements of Article 33(3) PCT regarding inventive step with respect to documents D2 and D7.

3.1. Document D2 (see in particular figures 1 and 2 and accompanying text) describes an electrical connector, and a method of manufacturing the same, comprising: providing a housing (16, 43, 20) with a plurality of through holes (14, 22) extending between a first and a second surface of the housing and defining a central axis; positioning a plurality of elongated contact members (10) in the through holes along their central axes, the contacts having first (12) and second (42) ends extending respectively above the first and second surface of the housing; and a resilient member (18) comprising a compliant encapsulating material (see column 3, lines 34 to 35: insulating elastomeric element) interposed between a portion of the contact members and the housing, such that the movement of the contact members (10) along their respective central axes is controlled. Since the contact members (10) are resiliently biased by the elastomeric element (18) (see abstract; column 1, lines 4 to 7), they are suitable

to electrically interconnect terminals on a flexible circuit member with terminals on a second circuit member.

- 3.2. The subject-matter of claims 1 and 42 differs from the teaching of D2 only in that the elastomeric element controlling the movement of the electric contacts is interposed between a portion of the electrical contacts and a portion of the respective through holes, instead of being a separate sheet as in D2 (see also applicant's response to the written opinion, page 2, the three last paragraphs).
- 3.3. This distinguishing feature is however a mere design option widely used in the art (see e.g. document D7, in particular figures 1 to 4 and accompanying text, which also relates to an array of elongated contact members resiliently retained in throughholes in a housing: as equivalent biasing means, D7 describes an elastomer sheet 28 as in figure 1, or an elastomeric cylinder 46 between contact member and throughhole as in figures 2 to 4; see also column 7, lines 62 to 65). The skilled person would use the latter option e.g. to obtain a more compact connector (since sheet 28 can now be dispensed with, thus allowing to reduce the overall thickness of the device), or to increase its mechanical strength (since for a constant device thickness, the space previously occupied by elastomer 28 is now occupied by housing 26). Thus starting from D2 and using only her general knowledge as illustrated by D7, she would arrive at the subject-matter of claims 1 and 42, which is therefore obvious.
4. The subject-matter of independent claims 17, 30 and 31 does not meet the requirements of Article 33(3) PCT regarding inventive step with respect to documents D3 and D5.
- 4.1. Document D3 (see in particular figures 1 to 3 and accompanying text) describes an electrical connector (see title: "test contactor") in an electrical interconnect assembly, and a method of manufacturing the same, where a flexible circuit member (consisting of an interface board 320 with contact pads 322, and of an anisotropic compliant conductive interposer 214; see page 6, lines 23 to 24) is electrically interconnected with a second circuit member (electrical component under test 202), comprising: providing a housing (guide plate 108) with a plurality of through holes (openings 206) extending between a first and a second surface

of housing (108) and defining a central axis; positioning a plurality of elongated contact members (208) in the through holes (206) along their central axes, the contacts having first (300) and second (310) ends extending respectively above the first and second surface of housing (108); and retaining the electrical contact members (208) in through holes (206) by a resilient member (namely the compliant interposer 314 which is part of the flexible circuit member) such that the movements of the contact members (208) along their respective central axes is controlled.

In his response to the written opinion (see page 3, paragraph 3), the applicant submits that the interposer (214) of D3 does not correspond to the flexible circuit member illustrated in figure 10 of the present application. However, said compliant conductive interposer (214) comprises conductors (352) which conduct electrical signals from contact members (208) to contact pads (322) of interface board (320) (see page 8, line 5 to page 9 line 12); thus, combined with said interface board (320), compliant interposer (214) *does* provide a flexible circuit member, albeit one which is flexible only *locally*. But even if was specified that the circuit member is flexible *as a whole* (e.g. a flexible PCB sheet as in the present application), this feature would not contribute to an inventive step, since it is merely a well known equivalent for resiliently controlling the movement of contact pins (see e.g. document D5, which also relates to a contactor with an array of resilient contact pins: in the embodiment of figure 15, resiliency is provided by an elastomeric sheet 41 on a rigid glass base 39, while in the embodiment of figures 6 and 8, the resiliency is provided through a flexible printed circuit film 34).

- 4.2. It is further noted that in D3, the housing (108) comprises a device site (200) for receiving the electrical component (202) (see figure 2; page 6, lines 14 to 16), and therefore anticipates the feature added by claim 21 of the present application.
- 4.3. Hence, the subject-matter of claims 17, 30 and 31 differs from the teaching of D3 only in that the electrical contact members have one surface *attached* to the terminals on the flexible circuit member. However, as discussed in section 4.1 above, the skilled person would use a flexible PCB sheet (like that disclosed in figures 6 and 8 of D5) as an equivalent to the flexible circuit member used in D3; in that case, she would attach the contact members to the terminals of the flexible

circuit member (e.g. by soldering) each time the requirement of a permanent (and thus more reliable) connection prevails over the opportunity of more easily reconfiguring the external circuitry (as is allowed by the flexible interposer used in D3; see also the discussion page 13, line 29 to page 14, line 5). Thus, starting from D3 and using only her general knowledge as illustrated by D5, she would arrive at the subject-matter of claims 17, 30 and 31, which is therefore obvious.

5. The dependent claims do not contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of article 33(3) PCT with respect to inventive step.
 - 5.1. The additional feature of claim 2 is rendered obvious by D5 (see figures 6 and 8, and in particular the contact pins 42 attached to the flexible circuit member 34; see also the discussion in section 4.3 above). That of claims 3, 18 and 33 is rendered obvious by D4 (see e.g. figures 2 and 15).
 - 5.2. The feature added by claims 4, 5, 19, 36 and 37 is known from D5 (see in particular in figure 6, the flexible circuit member (34) connected to the contact pins (42) of a probe card, the compliant member (33) and the back-up member (31, 32)). That added by claims 6, 21 and 41 is known from D3 (see figure 2 and page 6, lines 14 to 16: the housing 108 comprises a device site 200 for receiving the electrical component 202).
 - 5.3. The additional feature of claims 11 and 25 is known from D1 (see column 6, line 67 to column 7, line 2), as is that of claim 13 (see in figure 2, the tips 26), of claim 14 (see in figure 2, the heads 28), of claim 15 (as is readily seen from figure 1), of claim 27 (see in figure 2, the probes 24 extending through flex circuit 30) and of claim 40 (see again in figure 2, the tips 26 of the probes 24 engaging with the circuit elements on printed circuit board 12).
 - 5.4. The additional features of claim 7 (members and terminals to be connected having corresponding shapes), of claim 8, 22, 23 and 38 (type of contact and of circuit to be contacted), of claims 9 and 10 (composition and form of contact members), and of claims 12, 26 and 39 (method for contacting flexible circuit to

contact members) are mere design features which the skilled person would use according to circumstances without exceeding her ordinary competences.

- 5.5. The feature added by claims 16, 20, 24, 32 and 34 is known from each of D2 (resilient member 18) and D7 (resilient members 28 in figure 1 and 46 in figures 2 to 4). Those added by claims 28 and 29 are rendered obvious by D6 (see in figures 1 and 5, the flexible circuit 15 wrapped around a resilient member 16 and having contacts on its both sides, so that it can be used in any type of stacked assembly). That added by claim 35 is rendered obvious by D7 (see in figure 1, the compliant encapsulating layer 28).

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the document D7 is not identified in the description and the relevant background art disclosed therein is not at least briefly discussed.
2. Contrary to the requirements of Rule 6.3(b) PCT, the independent claims are not properly drafted in the two-part form, which is appropriate in the present case, with those features which in combination are part of the closest prior art (cf. e.g. documents D1 to D3) being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features in the characterizing part of the claim (Rule 6.3(b)(ii) PCT).
3. The features of the claims are not provided with reference signs placed in parentheses contrary to the requirement of Rule 6.2(b) PCT which applies to both the preamble and characterising portion.

Re Item VIII

Certain observations on the international application

1. Claim 1 seeks to define a physical entity (namely an electrical connector) by reference to the entity's use (namely for electrically interconnecting terminals on a flexible circuit member to ...). This gives rise to an ambiguity. The claim should

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/US00/20748

therefore refer to an "electrical connector *suitable* for electrically interconnecting terminals on a flexible circuit member to ...".

2. Claim 2 attempts to define a first entity (the electrical connector) in terms of its relationship to a second entity (the flexible circuit), which again gives rise to an ambiguity. Claim 2 should therefore be directed to an electrical interconnect *assembly* (like independent claim 30).

The same objection applies to claim 17 (see lines 25 to 26: "attached to ... the terminals on the flexible circuit member").

the conductive elements is generally not controllable. Elastomeric connectors may also exhibit a relatively high electrical resistance through the interconnection between the associated circuit elements. The interconnection with the circuit elements can be sensitive to dust, debris, oxidation, temperature
5 fluctuations, vibration, and other environmental elements that may adversely affect the connection.

The problems associated with connector design are multiplied when multiple integrated circuit devices are packaged together in functional groups. The traditional way is to solder the components to a printed circuit
10 board, flex circuit, or ceramic substrate in either a bare die silicon integrated circuit form or packaged form. Multi-chip modules, ball grids, array packaging, and chip scale packaging have evolved to allow multiple integrated circuit devices to be interconnected in a group.

One of the major issues regarding these technologies is the
15 difficulty in soldering the components, while ensuring that reject conditions do not exist. Many of these devices rely on balls of solder attached to the underside of the integrated circuit device which is then reflowed to connect with surface mount pads of the printed circuit board, flex circuit, or ceramic substrate. In some circumstances, these joints are generally not very reliable or
20 easy to inspect for defects. The process to remove and repair a damaged or defective device is costly and many times results in unusable electronic components and damage to other components in the functional group.

Multi-chip modules have had slow acceptance in the industry due to the lack of large scale known good die for integrated circuits that have been
25 tested and burned-in at the silicon level. These dies are then mounted to a substrate which interconnect several components. As the number of devices increases, the probability of failure increases dramatically. With the chance of one device failing in some way and effective means of repairing or replacing currently unavailable, yield rates have been low and the manufacturing costs
30 high.

What Is Claimed Is:

1. An electrical connector for electrically interconnecting terminals on a flexible circuit member with terminals on a second circuit member, the electrical connector comprising:
 - a housing having a plurality of through holes extending between a first surface and a second surface, each of the through holes defining a central axis;
 - a plurality of elongated electrical contacts positioned in at least a portion of the through holes and oriented along the central axes, the electrical contacts having first ends extending above the first surface adapted to couple electrically with the terminals on the flexible circuit member, and second ends extending above the second surface to couple electrically with the second circuit member; and
 - a resilient member controlling movement of the electrical contacts along their respective central axes.
2. The electrical connector of claim 1 wherein the resilient member comprises a compliant encapsulating material interposed between a portion of the through hole and a portion of the electrical contacts.
3. The electrical connector of claim 1 wherein the resilient member comprises a compliant encapsulating material surrounding a portion of the electrical contacts along the first surface of the housing.
4. The electrical connector of claim 1 wherein the resilient member comprises the flexible circuit member.
5. The electrical connector of claim 1 wherein the resilient member comprises singulated terminals on the flexible circuit member.

6. The electrical connector of claim 1 wherein the resilient member comprises a compliant material positioned along a surface of the flexible circuit member opposite the terminals of the flexible circuit member.

5

7. The electrical connector of claim 6 further including a back-up member supporting the compliant material.

8. The electrical connector of claim 1 wherein the second surface of the housing includes at least one device site corresponding to the second circuit member.

9. The electrical connector of claim 1 wherein the second ends of the electrical contacts have a shape that corresponds to a shape of the terminals on the second circuit member.

10. The electrical connector of claim 1 wherein the second ends of the electrical contacts are capable of engaging with a connector member selected from the group consisting of a flexible circuit, a ribbon connector, a cable, a printed circuit board, a ball grid array (BGA), a land grid array (LGA), a plastic leaded chip carrier (PLCC), a pin grid array (PGA), a small outline integrated circuit (SOIC), a dual in-line package (DIP), a quad flat package (QFP), a leadless chip carrier (LCC), a chip scale package (CSP), or packaged or unpackaged integrated circuits.

25

11. The electrical connector of claim 1 wherein the electrical contacts are one of a homogeneous material or a multi-layered construction.

12. The electrical connector of claim 1 wherein the electrical contacts have a cross-sectional shape selected from one of circular, oval, polygonal, and rectangular.
- 5 13. The electrical connector of claim 1 wherein a portion of the flexible circuit member is bonded to the first surface of the housing with an adhesive.
- 10 14. The electrical connector of claim 1 wherein the electrical contacts are electrically coupled to the flex circuit using one or more of compressive force, solder, wedge bonding, conductive adhesives, ultrasonic bonding and wire bonding.
- 15 15. The electrical connector of claim 1 wherein the second ends of at least two of the electrical contacts extend beyond the second surface of the housing by a different amount.
- 20 16. The electrical connector of claim 1 wherein electrical contacts have a larger cross section proximate the first end than at the second end.
17. The electrical connector of claim 1 wherein the plurality of through holes are arranged in a two-dimensional array.
- 25 18. The electrical connector of claim 1 wherein the resilient member comprises a compliant encapsulating member elastically bonding the electrical contacts to the housing.

19. An electrical connector for electrically interconnecting terminals on a flexible circuit member with terminals on a second circuit member, the electrical connector comprising:

5 a housing having a plurality of through holes extending between a first surface and a second surface, each of the through holes defining a central axis;

a plurality of elongated electrical contacts positioned in at least some of the through holes and oriented along the central axes, the electrical contacts having first ends extending above the first surface and coupling
10 electrically with the terminals on the flexible circuit member, and second ends extending above the second surface to couple electrically with the second circuit member; and

a resilient member controlling movement of the electrical contacts along their respective central axes.

15

20. The electrical connector of claim 19 wherein the compliant encapsulating member elastically bonds the electrical contacts to the housing.

20 21. An electrical interconnect assembly for electrically coupling with a second circuit member, comprising:

a flexible circuit member having terminals along a first surface;
a housing having a plurality of through holes extending between
a first surface and a second surface, each of the through holes defining a central
25 axis;

a plurality of elongated electrical contacts positioned in at least some of the through holes and oriented along the central axes, the electrical contacts having first ends extending above the first surface and electrically coupled with the terminals on the flexible circuit member, and second ends

extending above the second surface to couple electrically with the second circuit member; and

a resilient member controlling movement of the electrical contacts along their respective central axes.

5

22. The electrical interconnect assembly of claim 21 wherein the second surface of the housing includes at least one device site.

23. The electrical interconnect assembly of claim 21 wherein
10 the second circuit member is one of a printed circuit board, a flexible circuit, a bare-die device, an integrated circuit device, an organic or inorganic substrate, a rigid circuit, or a wafer containing a plurality of integrated circuit devices.

24. The electrical interconnect assembly of claim 21 wherein
15 the second ends of the electrical contacts comprises one or more of die level test probes, wafer probes, and printed circuit board probes.

25. The electrical interconnect assembly of claim 21 wherein
the resilient member comprises one of a compliant encapsulating material
20 interposed between a portion of the through hole and a portion of the electrical contacts, a compliant encapsulating material surrounding a portion of the electrical contacts along the first surface of the housing, the flexible circuit member, singulated terminals on the flexible circuit member, or a compliant material positioned along a surface of the flexible circuit member opposite the
25 terminals.

26. The electrical interconnect assembly of claim 21 wherein
a portion of the flexible circuit member is bonded to the first surface of the housing with an adhesive.

30

27. The electrical interconnect assembly of claim 21 wherein the electrical contacts are electrically coupled to the flex circuit using one or more of compressive force, solder, wedge bonding, conductive adhesives, ultrasonic bonding and wire bonding.

5

28. The electrical interconnect assembly of claim 21 wherein the first end of at least one of the electrical contacts extends through the flexible circuit member.

10

29. The electrical interconnect assembly of claim 21 wherein the flexible circuit member is folded over a resilient member to electrically couple two electrical interconnect assemblies in a stacked configuration.

30. The electrical interconnect assembly of claim 21 wherein the flexible circuit member comprises electrical contact pads along a second surface thereof.

31. An electrical interconnect assembly for electrically coupling with a second and a third circuit member, comprising:

20 a flexible circuit member having a plurality of terminals;

a first housing having a plurality of through holes extending between a first surface and a second surface, each of the through holes defining a central axis, a plurality of elongated electrical contacts positioned in at least some of the through holes and oriented along the central axes, the electrical

25 contacts having first ends extending above the first surface and electrically coupled to terminals on the flexible circuit member, and second ends extending above the second surface to couple electrically with the second circuit member;

a second housing having a plurality of through holes extending between a first surface and a second surface, each of the through holes defining

30 a central axis, a plurality of elongated electrical contacts positioned in at least

some of the through holes and oriented along the central axes, the electrical contacts having first ends extending above the first surface and electrically coupled to terminals on the flexible circuit member, and second ends extending above the second surface to couple electrically with the third circuit member,
5 the first surface of the first housing being positioned opposite the first surface of the second housing; and

a resilient member controlling movement of the electrical contacts along their respective central axes.

10 32. A method of making an electrical interconnect comprising the steps of:

providing a housing with a plurality of through holes extending between a first surface and a second surface, each of the through holes defining a central axis;

15 positioning a plurality of elongated electrical contacts in at least some the through holes oriented along the central axes, the electrical contacts having first ends extending above the first surface;

retaining the electrical contacts in the through holes; and

20 electrically coupling the first ends with the terminals on a flexible circuit member so that the second ends extending above the second surface.

33. The method of claim 32 comprising the step of applying a resilient member to control movement of the electrical contacts along their respective central axes.

25

34. The method of claim 32 comprising the step of singulating the terminals on the flexible circuit member.

35. The method of claim 32 wherein the step of positioning a
30 plurality of electrical contacts in the through holes comprises the steps of:

applying a soldermask material along the first surface;
planarizing the soldermask material and a portion of the electrical
contacts extending above the first surface; and
removing the soldermask.

5

36. The method of claim 35 comprising the step of applying a resilient member to control movement of the electrical contacts along their respective central axes before applying the soldermask.

10

37. The method of claim 35 comprising the step modifying the shape of the first or second ends of the electrical contacts by etching, grinding, abrating, ablating before removing the solder mask.

15

38. The method of claim 32 wherein the step of retaining the electrical contacts in the through holes comprises interposing a compliant encapsulating material between a portion of the through hole and a portion of the electrical contacts.

20

39. The method of claim 32 wherein the step of retaining the electrical contacts in the through holes comprises surrounding a portion of the electrical contacts with a compliant encapsulating material along the first surface of the housing.

25

40. The method of claim 32 wherein the step of retaining the electrical contacts in the through holes comprises bonding the electrical contacts to the terminals on the flexible circuit member.

30

41. The method of claim 40 wherein the step of retaining the electrical contacts in the through holes comprises positioning a complaint material along a surface of the flexible circuit member opposite the terminals.

42. The method of claim 32 wherein the step of retaining the electrical contacts in the through holes comprises bonding the electrical contacts to the terminals on the flexible circuit member and singulating one or more of the terminals.

43. The method of claim 42 further comprising positioning a back-up member behind the compliant material.

44. The method of claim 32 wherein the second ends of the electrical contacts are modified to have a shape capable of engaging with a second circuit member selected from the group consisting of a flexible circuit, a ribbon connector, a cable, a printed circuit board, a ball grid array (BGA), a land grid array (LGA), a plastic leaded chip carrier (PLCC), a pin grid array (PGA), a small outline integrated circuit (SOIC), a dual in-line package (DIP), a quad flat package (QFP), a leadless chip carrier (LCC), a chip scale package (CSP), packaged and unpackaged integrated circuits.

45. The method of claim 32 wherein the electrical contacts are electrically coupled to the flex circuit using one or more of compressive forces, solder, wedge bonding, conductive adhesives, ultrasonic bonding and wire bonding.

46. The method of claim 32 comprising the step of engaging the second ends of the electrical contacts with a second circuit member.

47. The method of claim 32 comprising the step of preparing at least one device site on the second surface of the housing.

48. A method of making an electrical interconnect for electrically coupling terminals on a flexible circuit member with terminals on a second circuit member, comprising the steps of:
- 5 providing a housing having a plurality of through holes extending between a first surface and a second surface, each of the through holes defining a central axis;
- 10 positioning a plurality of elongated electrical contacts in at least some of the through holes oriented along the central axes, the electrical contacts having first ends extending above the first surface; and
- elastically bonding the electrical contacts in the through holes.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 220294	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/US 00/ 20748	International filing date (<i>day/month/year</i>) 31/07/2000	(Earliest) Priority Date (<i>day/month/year</i>) 02/08/1999
Applicant GRAPHICS, INC.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.
☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

- ☐ as suggested by the applicant.
- ☐ because the applicant failed to suggest a figure.
- ☒ because this figure better characterizes the invention.
- 1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 00/20748

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

1-2, 4-24, 25 (as far as it does NOT recite the features of claim 3),
26-38, 40-48

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-2, 8-24,
25 (as far as it recites the features of claim 2),
26-28, 31-33, 38, 44-48

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material between a portion of the through holes and a portion of the respective contact members.

2. Claims: 3,
25 (as far as it recites the features of claim 3),
39

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material surrounding a portion of the electrical contacts along a surface of the housing.

3. Claims: 4-7,
25 (as far as it recites the features of claims 4 to 6), 29-30, 34, 40-43

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a flexible circuit member.

4. Claims: 35-37

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Method of manufacturing an electrical interconnect assembly, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where the contact members are retained in the through holes, characterized in that a solder mask is applied to a surface of the housing, and that then the solder mask is planarized together with the contact members.

INTERNATIONAL SEARCH REPORT

International Application No

P S 00/20748

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/66 G01R1/067 G01R1/073

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<div> <div>✓</div> <div>US 5 252 916 A (SWART MARK A) 12 October 1993 (1993-10-12)</div> </div> <div> <div>✓</div> <div>column 6, line 20 -column 9, line 46; figures 1,2</div> </div>	1,13, 15-17, 19,21, 26,28, 31,32,46
X	<div> <div>✓</div> <div>US 4 118 090 A (DEL MEI LUIGI GIOVANNI) 3 October 1978 (1978-10-03)</div> </div> <div> <div>✓</div> <div>column 1, line 4 -column 4, line 48; figures 1,2</div> </div>	1,2, 8-28, 31-33, 38,44-48
Y	<div> <div>✓</div> <div>---</div> </div> <div> <div>✓</div> <div>---</div> </div>	4-7,25, 29,30, 34,40-43

	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

23 March 2001

Date of mailing of the international search report

- 4. APR. 2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Munnix, S

INTERNATIONAL SEARCH REPORT

International Application No

PC 00/20748

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A ✓	US 5 410 260 A (KAZAMA TOSHIO) 25 April 1995 (1995-04-25) figure 7	1,2, 8-28, 31-33, 38,44-48
X ✓	WO 98 13695 A (PRIMEYIELD SYSTEMS INC) 2 April 1998 (1998-04-02) page 6, line 13 -page 8, line 26; figures 2,3	1,4,6-9, 16,22, 25,32, 40,41, 43,47
A ✓	US 5 723 347 A (HIRANO TOSHIKI ET AL) 3 March 1998 (1998-03-03) figures 2,15	5
Y ✓	US 5 412 329 A (IINO SHINJI ET AL) 2 May 1995 (1995-05-02) figure 6	4-7,25, 29,30, 34,40-43
A ✓	EP 0 310 302 A (MINNESOTA MINING & MFG) 5 April 1989 (1989-04-05) figures 1,5	29,30
X ✓	US 5 521 519 A (FAURE LOUIS H ET AL) 28 May 1996 (1996-05-28) column 3, line 15 - line 62; figure 2	35-37
A ✓	US 5 299 090 A (BRADY KEVIN J ET AL) 29 March 1994 (1994-03-29) column 3, line 3 - line 10; figure 3	35-37
A ✓	US 5 637 539 A (HOFMANN WOLFGANG ET AL) 10 June 1997 (1997-06-10) column 1, line 5 - line 33 column 5, line 3 - line 36 figures 6,7,22	35-37

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC 00/20748

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5252916	A	12-10-1993	US 5389885 A WO 9315409 A US 5447442 A	14-02-1995 05-08-1993 05-09-1995
US 4118090	A	03-10-1978	ZA 7703036 A	30-08-1978
US 5410260	A	25-04-1995	JP 2532331 B JP 6148236 A	11-09-1996 27-05-1994
WO 9813695	A	02-04-1998	EP 0928422 A	14-07-1999
US 5723347	A	03-03-1998	JP 2710544 B JP 7113842 A US 5625298 A EP 0646800 A	10-02-1998 02-05-1995 29-04-1997 05-04-1995
US 5412329	A	02-05-1995	JP 2966671 B JP 5218150 A KR 196195 B	25-10-1999 27-08-1993 15-06-1999
EP 0310302	A	05-04-1989	US 4859189 A CA 1289681 A DE 3851932 D DE 3851932 T JP 1121776 A KR 9703521 B	22-08-1989 24-09-1991 01-12-1994 24-05-1995 15-05-1989 18-03-1997
US 5521519	A	28-05-1996	US 5600883 A US 5718040 A	11-02-1997 17-02-1998
US 5299090	A	29-03-1994	CA 2123287 A,C DE 69406201 D DE 69406201 T EP 0632498 A JP 7321259 A	30-12-1994 20-11-1997 19-02-1998 04-01-1995 08-12-1995
US 5637539	A	10-06-1997	NONE	